

THE FAMILY TRYPETHELIACEAE (LOCULOASCOMYCETES: LICHENIZED MELANOMMATALES) IN AMAZONIAN BRAZIL.

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SUMMARY

The family Trypetheliaceae is redefined including a key to the genera. *Exiliseptum* gen. nov. is described. Keys to the species are provided for the six genera which occur in Amazonian Brazil along with brief comments on the three other genera. Thirty-five species are included, ten new species described and ten new combinations proposed.

INTRODUCTION

The Trypetheliaceae are a large family of tropical crustose lichens, many of them brightly colored. Even so there are not a large number of collections from Amazonian Brazil but those that have been made have proved important in elucidating the phylogeny and phytogeography of the family. Recent Projeto Flora Amazônica specimens have been particularly significant. Eight of the ten new species described here were collected by Projeto Flora Amazônica sponsored expeditions. The only other material available is that collected by Richard Spruce over 100 years ago. Thirty-five species are treated but I would estimate that this is only half or less of the Trypetheliaceae occurring in Amazonian Brazil.

This is the first substantial treatment of the Trypetheliaceae as a clearly delimited unit. The only previous publications are Letrouit-Galinou's (1957) survey of Laurera and Malme's (1924) treatment of 18 species from southern Brazil and Paraguay. The North American taxa have been treated in my unpublished thesis (Harris, 1975). I have taken this lack of published information as justification for including as much of the synonymy as possible.

Taxonomy

TRYPETHELIACEAE Eschw.

Syst. lich. 17. 1824. Type: *Trypethelium* Sprengel.

Astrotheliaceae Zahlbr., Nat. Pflanzenfam. 1(1\*): 72. 1903. Type: *Astrothelium* Eschw.

Cryptotheliaceae W. Wats., New Phytol. 28: 113. 1929. Type: *Cryptothelium* Massal.

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Hyalophragmiaceae Räs., Acta Bot. Fenn. 33: 9,23,74. 1943. nom. inval. (Art. 36).  
Lectotype (Cooke & Hawksworth, 1970): **Pseudopyrenula** Müll. Arg.

Pleurotrematomyceaceae Cif. & Tom., Ist. Bot. Reale Univ. Reale Lab. Crittog. Pavia  
Atti ser. 5,16: 6. 1957. nom. illeg. (Art. 63). Type: **Pleurotrematomyces** Cif. & Tom.  
(= **Pleurotrema** Müll. Arg.).

Melanothecomycaceae Cif. & Tom., Ist. Bot. Reale Univ. Reale Lab. Crittog. Pavia  
Atti ser. 5, 16: 7. 1957. Type: **Melanothecomycetes** Cif. & Tom. (= **Laurera** Reichenb.).

Laureraceae Vězda ex Poelt in Ahmadjian & Hale, The Lichens 609. 1974. nom. inval.  
(Arts. 34.1(b), 35). Type: **Laurera** Reichenb.

Thallus corticolous, crustose, varying from well developed with a distinct cortex and medulla to poorly developed and distinguishable only by the discoloration of the bark. Cortex of highly gelatinized and compacted hyphae and bark cells, rarely pseudocyphellate. Medulla often filled with crystals. Phycobiont **Trentepohlia**. Ascomata simple or divided into several-many chambers with a black ("carbonized") wall containing bark cells and often colorless or pigmented crystals (virtually lacking in some when deeply immersed in bark): solitary or aggregated, often with additional pseudostromatic tissues which may be multilayered and include crystals or various pigments. Ostioles apical, eccentric or lateral (compound ascomata may have single ostioles or several rising closely aggregated). Hamathecium of loosely trabeculate paraphysoids immersed in much gelatin (always IKI-), often heavily inspersed with oily granules. Asci usually cylindrical with a broad, usually shallow ocular chamber, with fissitunicate dehiscence. Spores mostly 8/ascus but occasionally reduced to 1,2 or 4/ascus, 3-many transversely septate to muriform, some very large up to 300 µm, colorless (while remaining in ascomata but many collected from bark have turned brown), sometimes IKI+ violet, surrounded by a gelatinous sheath; inner layer of spore wall often thickened but this may be lost in some reduced genera and only evident in postmature spores. Microconidia rod-shaped, in pycnidia in which the chamber may become labyrinthiform, or inside old ascospores. Macroconidia not known.

Lichen substances only lichexanthone and various pigments including anthraquinones such as parietin.

There are probably ca. 100 species in the Neotropics and 200+ worldwide.

Trypetheliaceae was published by Eschweiler as "cohors" but referred to in the text as "familia" and used in the current sense of a family. If one wishes to interpret Eschweiler's usage as an order, then the family may be treated as published by Zenker in Goebel & Kunze (1827).

The Trypetheliaceae as defined here include nine genera, **Astrothelium**, **Campylothelium**, **Cryptothelium**, **Exiliseptum** gen. nov., **Laurera**, **Pleurotrema**, **Polymeridium**, **Pseudopyrenula** and **Trypethelium**. Eriksson (1981, 1984) includes Massariaceae Nits. (**Aglaospora** De Not. & **Massaria** De Not.) as a subfamily of the Trypetheliaceae. It is my

opinion that although the spores of the two groups are rather similar they are amply distinct in all other respects. Especially striking is the massive apical ring in the ascus of Massariaceae. I agree that the Massariaceae, Pyrenulaceae and Trypetheliaceae probably have a common origin. I do not agree that the Trypetheliaceae is nearest the primitive group with the Massariaceae representing a delichenized offshoot. The Trypethelium type of ascus seems easily derived by reduction from that of Massaria but to evolve the massive apical ring from Trypethelium seems less probable. Delichenization does seem to be an important trend in the Trypetheliaceae (see Exiliseptum, Pleurotrema and Polymeridium) but it is accompanied by simplification of the ascomata, asci and spores. On the basis of phytogeography the Trypetheliaceae seem to be a relatively young group. Two distinct centers of diversity exist (northern South America and Southeast Asia) and there are relatively few pantropical species. Also the widely distributed species do not show much significant variation. In contrast the Pyrenulaceae show no obvious centers and many species have relictual, often hyperoceanic, distributions. Some "species" seem to have diverged into "microspecies" in several major phytogeographic regions implying populations of a widespread species which have been isolated long enough to begin evolving apart. The Trypetheliaceae are strictly tropical and subtropical (except for Trypethelium virens Tuck. in N. America and Japan) occurring only on bark while the Pyrenulaceae have a considerable number of temperate species and occur on a wider variety of substrates. I interpret these distributional data as evidence that the Pyrenulaceae has been in existence considerably longer than the Trypetheliaceae. The Massariaceae have an even more restricted distribution, apparently confined to Eastern North America and Europe. Also the two genera, Aglaospora and Massaria, have quite different spore types adding emphasis to the relictual distribution and more complicated ascus structure suggesting that the Massariaceae represent remnants of the group which gave rise to the Pyrenulaceae and later the Trypetheliaceae.

Of the genera not treated here which are tentatively included in the Trypetheliaceae by Eriksson (1984) Riddlea Dodge = Laurera, Trypetheliopsis Asah. almost certainly = Trypethelium and Buscalonia Cengia Sambo needs to be investigated. The remainder, Bottaria Massal., Lithothelium Müll. Arg., Melanotheca Fée, Parmenteria Fée, Pleurotheliopsis Zahlbr., Pyrenastrum Eschw., Titanella Syd. & Syd. (= Anthracothecium Massal.), belong in the Pyrenulaceae.

Since much of the evolution within the Trypetheliaceae seems extant, natural breaks are not obvious and the generic concepts are mostly artificial, placing closely related species in different genera, e.g., Astrothelium variolosum-Trypethelium ochroleucum and others mentioned in the discussions below. However, I do not wish to suggest any reorganization until monographic studies are completed, nor do I care to reduce everything to a single genus which is another, not entirely unreasonable, option.

Only six of the nine genera have been found in Amazonian Brazil, however the other three (Campylothelium, Pleurotrema and Pseudopyrenula) are included in the generic key and a few extra-Amazonian species are discussed.

## Key to genera

1. Ascomata compound with several cavities joined in a common ostiolar neck, solitary or aggregated, often in variously raised and/or pigmented pseudostromata ..... 2
2. Spores muriform ..... **Cryptothelium**
2. Spores transversely septate or with a few cells longitudinally septate (submuriform)..... 3
3. Spore wall thickened; thallus well developed; ascomata often in pigmented pseudostromata ..... **Astrothelium**
3. Spore wall thin (thickening in post mature spores); ascomata not aggregated in pseudostromata ..... 4
4. Thallus well developed; spores 4-celled or submuriform ..... **Exiliseptum**
4. Thallus poorly developed; spores 3- or 4-celled ..... 5
5. Spores 3-celled ..... [**Pleurotrema acrophaeum**]
5. Spores 4-celled ..... **Polymeridium biloculare**
1. Ascomata simple, naked or included in raised and/or pigmented pseudostromata ..... 6
6. Spores muriform ..... 7
7. Ostiole apical ..... **Laurera**
7. Ostiole lateral ..... **Campylothelium**
6. Spores transversely septate ..... 8
8. Ostioles lateral; spores thin walled, 3-celled ..... [**Pleurotrema polysemum**]
8. Ostiole apical; spores 4-many-celled ..... 9
9. Thallus well developed, often with a distinct cortex; ascomata mostly aggregated in pseudostromata or immersed in thallus ..... **Trypethelium**
9. Thallus poorly developed, cortex lacking; ascomata naked, never in pseudostromata, rarely somewhat immersed in bark.....10
10. Spore wall thickened ..... **Pseudopyrenula**
10. Spore wall thin (sometimes thickening in postmature spores).....  
..... **Polymeridium**

## **ASTROTHELUM** Eschw.

Syst. lich. 18. 1824. Lectotype (Massalongo, 1860): **A. conicum** Eschw.

**Heufleria** Trevis., Spighe e Pagine 19. 1853. Holotype: **Astrothelium conicum** Eschw.

## Key to Amazonian species of **Astrothelium**

1. Spores more than 4-celled ..... 2
2. Spores 20-23-celled, 105-115 x 18-20  $\mu\text{m}$ , becoming brownish ..... **A. gigasporum**
2. Spores 6-celled ..... 3
3. Pseudostromata UV+ yellow; thallus UV-; spores 25-30 x 9-11  $\mu\text{m}$ , often some 4-celled spores present; hymenium not interspersed ..... **A. eustomum**
3. Pseudostromata and thallus UV-; spores 60-70 x 15-17  $\mu\text{m}$ ; hymenium heavily interspersed ..... **A. subclandestinum**

1. Spores 4-celled. .... 4
4. Pseudostromata pigmented orange, KOH+ purple, pigment, often confined to small area around the ostiole ..... 5
  5. Thallus UV-; spores 23-30 x 8-10  $\mu\text{m}$  ..... **A. cinnamomeum**
  5. Thallus UV+ yellow (lichexanthone) ..... 6
    6. Spores 37-45 x 13-16  $\mu\text{m}$  ..... **A. ochrothelium**
    6. Spores mostly less than 35 x 13  $\mu\text{m}$  ..... 7
      7. Spores 28-35 x 10-13  $\mu\text{m}$  ..... **A. versicolor**
      7. Spores 21-28 x 7-9  $\mu\text{m}$  ..... **A. galbineum**
4. Pseudostromata not pigmented ..... 8
  8. Thallus or only pseudostromata UV+ yellow (lichexanthone) ..... 9
    9. Thallus UV+ yellow; spores 20-25 x 7.5-10  $\mu\text{m}$  ..... **A. variolosum**
    9. Thallus UV-; pseudostromata or whitish areas around ostioles UV+ yellow ... 10
      10. Thallus fragile with white pseudocyphellae; hymenium not interspersed; spores 23-27 x 7-8  $\mu\text{m}$  ..... **A. pseudocyphellatum**
      10. Thallus not fragile, lacking pseudocyphellae ..... 11
        11. Ascomata solitary, scattered, immersed in thallus; hymenium heavily interspersed; spores 23-27 x 8-9  $\mu\text{m}$  ..... **A. punctulatum**
        11. Ascomata aggregated in orbicular or elliptical decorticate pseudostromata; hymenium not interspersed; spores 25-30 x 9-11  $\mu\text{m}$ ..... **A. interjectum**
  8. Thallus UV- ..... 12
    12. Spores 23-27 x 8-10  $\mu\text{m}$ ; ascomata large, immersed to emergent; solitary or few aggregated, thalline covering often eroding and exposing black wall; hymenium not interspersed ..... **A. subfuscum**
    12. Spores 27-32 x 8-10  $\mu\text{m}$ ; ascomata large, remaining covered by thallus; hymenium not interspersed ..... **A. sulphureum**

**Astrothelium cinnamomeum** (Eschw.) Müll. Arg.

Flora 68: 270. 1884. *Pyrenastrum cinnamomeum* Eschw. in Mart., Icon. Pl. Crypt. 18, pl. 9, f. 1. 1828. Holotype: Brazil: Bahia, Caetitê, Martius (M).

*Astrothelium minus* Müll. Arg., Bot. Jahrb. Syst. 6: 382. 1885. Type collection: Cuba, Wright Verr. Cub. 235. Isotypes in FH-Tuck 3982, NY & US, syn. nov.

*Astrothelium minus* var. *nigratum* Müll. Arg., Bot. Jahrb. Syst. 6: 382. 1885. Type collection: Cuba, Wright Verr. Cub. 11. 638. Isotype in FH-Tuck 3982, syn. nov.

My circumscription of *A. cinnamomeum* is the same as the general concept of *A. conicum* Eschw., but I have not located type material and cannot confirm to which of the very similar taxa in this group *A. conicum* applies. *Astrothelium ochrothelioides* Vainio is probably also a synonym of *A. cinnamomeum* but the isotypes examined are without spores.

In this group distinguished by orange pseudostromata the following taxa may be

***Astrothelium gigasporum*** R. C. Harris sp. nov.

*Astrothelium sporis magnis*, 105-115 x 18-20  $\mu$ m, 20-23-locularibus. Holotype: Brazil. Amazonas, along Rio Curicuriari and Igarapé Branco (Rio Cariva) from Rio Curicuriari to Cachoeira de Boto (Cachoeira Piraiwara), 00°20'S, 66°55'W, Buck 2532 (INPA). Isotypes in NY and to be distributed.

Thallus variously colored, green to tan, mottled yellowish or whitish, paler a round ascomata, shiny; cartilaginous cortex well developed; medulla thin, filled with colorless crystals; UV-. Ascomata with 2-8 chambers, immersed in bark or becoming superficial in some specimens, mostly solitary. Ostioles sometimes forming large papillae which may become elongated and isidium-like. Wall carbonized, without colorless crystals. Hymenium not interspersed. Spores 8/ascus,  $\pm$  biseriata, 20-23-celled, narrowly fusiform, 105-115 x 18-20  $\mu$ m, often becoming brownish, IKI-. (Fig. 1).

*Astrothelium gigasporum* is unique in the genus by its very large multiseptate spores. The only species approaching it is an undescribed species from Brazil among the *Glaziou reliquiae* (G) which has spores nearly as large but with fewer cells (10-11) and which react violet with IKI. *Astrothelium gigasporum* is phytogeographically interesting because this spore type is otherwise only known in a few Southeast Asian species of *Trypethelium* and may represent a Paleotropical element in the Brazilian flora. It is apparently endemic to Amazonian Brazil and Venezuela.

Additional specimens examined. AMAZONAS: Along Rio Curicuriari and Igarapé Branco, Buck 2539; Rio Uatumã at end of Lago de Tucumanduba, Buck 2816; Along Igarapé Caititu off Rio Uatumã, Buck 2940, 2946. RORAIMA: Acampamento do 6º BEC-Jundiã, Buck [Dumont BR 338] (all INPA, NY).

VENEZUELA, AMAZONAS: Along Río Mawarinuma, vicinity of Neblina base camp, Buck 11371 (NY, VEN).

***Astrothelium interjectum*** R. C. Harris sp. nov.

*Astrothelium inter A. variolosum* et *A. sulphureum* thallo UV- sed pseudostromatibus UV+ aureis ut in *A. leucoconico*, ab eo differt sporis minoribus, 25-30 x 9-11  $\mu$ m. Holotype: Brazil: Amazonas, Serra Aracã, 60m, Samuels 838 (INPA). Isotype in NY.

Thallus light gray green, rather thin with a well developed cortex and thin to medium white medulla filled with colorless crystals; UV-. Ascomata several chambered, aggregated in orbicular to irregular, conical to hemispherical, decorticate, whitish pseudostromata which are UV+ yellow (lichexanthone, not confirmed by TLC). Wall carbonized, without colorless crystals. Hymenium not interspersed. Spores 8/ascus,  $\pm$  biseriata, 4-celled, fusiform, 25-30 x 9-11  $\mu$ m, IKI-. (Fig. 4).

*Astrothelium interjectum* has spore size and pseudostromatal characters which ally it with *A. subfuscum*, *A. sulphureum* and *A. variolosum* (see also discussion of *A. subfuscum*). The first two lack lichexanthone while the third has the entire thallus UV+ yellow. *Astrothelium leucoconicum* Nyf. is superficially identical with only the

pseudostromata UV+ yellow but has larger spores (65-70  $\mu\text{m}$ ) and an inspersed hymenium. *Astrothelium punctulatum* is similar to *A. interjectum* in spore size and in being UV+ yellow around the ostioles but has solitary, scattered, immersed ascomata. Thus *A. interjectum* could be considered intermediate between *A. sulphureum* and *A. variolosum* in thallus reactions or between *A. punctulatum* and *A. leucoconicum* in pseudostromatal development and spore size.

Additional specimen examined. AMAZONAS: 0-3 km S of central portion of Serra Aracá, 60 m, **Samuels 842** (INPA, NY).

*Astrothelium ochrothelium* (Nyl.) Müll. Arg.

Flora 68: 255. 1885. *Trypethelium ochrothelium* Nyl., Acta Soc. Sci. Fenn. 7: 494. 1863. Lectotype (selected here): Colombia, Villeta, 2000 m, **Lindig 2823** (H-NYL 266). Isolectotypes in BM, FH-Tuck 3973 & M.

See discussion under *A. cinnamomeum*.

Distribution. Cuba, Jamaica, Trinidad, French Guiana, Guyana, Colombia and Venezuela.

Specimens examined. AMAZONAS: Along Igarapé Caititu off Rio Uatumã, **Buck 2961** (INPA, NY); Savanna just W of Humaitã, **Reese 12706** (INPA, NY).

*Astrothelium pseudocyphellatum* R. C. Harris sp. nov.

*Astrothelium punctulato* similis sed thallo fragile albo pseudocyphellato et hymenio non insperso.

Holotype: Brazil: Amazonas, São Gabriel, **Spruce 247** (BM ex K, hb. Leighton). Isotype in BM.

Thallus light green, rather thick,  $\pm$  rugose, fragile, white pseudocyphellate; UV-; areas around ostioles whitish, UV+ yellow (lichexanthone, not confirmed by TLC). Ascomata scattered, solitary, immersed, several chambered. Wall carbonized, without colorless crystals. Hymenium not inspersed. Spores 8/ascus,  $\pm$  biseriolate, 4-celled, fusiform, 23-27 x 7-8  $\mu\text{m}$ , IKI-. (Fig. 5).

*Astrothelium pseudocyphellatum* is unique in having pseudocyphellae. This is a very common character in the related family Pyrenulaceae but it is otherwise unknown in the Trypetheliaceae. *Astrothelium eustomum* and *A. punctulatum* are similar in producing lichexanthone only around the ostioles, both lack pseudocyphellae and *A. eustomum* has 6-celled spores. *Astrothelium pseudocyphellatum* is known only from the type.

*Astrothelium punctulatum* Malme

Ark. Bot. 19(1): 14. 1924. Type collection: Brazil: Mato Grosso, Santa Ana da Chapada, 2. III. 1894 **Malme**, Lich. Regnell. 2457. Isotype in MSC.

I regard *A. punctulatum* as closely related to *A. interjectum*, differing in having solitary, simpler ascomata. It is possible that they represent extremes of a continuum. A possible counterpart lacking any UV reactions is *A. confusum* Müll. Arg.

Distribution. Cuba, Brazil.

Specimen examined. PARÁ: Pará (Belém), Carissi, 1849, Spruce (BM, M).

**Astrothelium subclandestinum** Leighton

Trans. Linn. Soc. Lond. 25: 460, pl. 56, f. 27. 1866. Holotype: Brazil, Amazonas, São Gabriel, Spruce 242 (BM ex K).

**Astrothelium subclandestinum** is known only from the type collection and does not seem to have any obvious relatives. The relatively large (60-70 µm) 6-celled spores are diagnostic.

**Astrothelium subfuscum** Krempelh.

Nuovo Giorn. Bot. Ital. 7: 64. 1875. Holotype: Singapore, Beccari 236 (M).

**Trypethelium peranceps** Krempelh., Nuovo Giorn. Bot. Ital. 7: 55. 1875. Lectotype (selected here): Sarawak, Beccari 112 (M), syn. nov.

**Astrothelium subfuscum** is largely characterized by the loss of thallus exposing the carbonized apices of the ascomata. Brazilian collections have slightly larger spores than those from the Paleotropics. **Astrothelium subfuscum** is part of a difficult group which includes **A. confusum** Müll. Arg. and the next two species, **A. sulphureum** and **A. variolosum**. **Astrothelium variolosum** may be distinguished by the presence of lichexanthone in the thallus but it remains to be determined whether this should be treated as worthy of specific rank. **Astrothelium sulphureum** has slightly larger spores than the other three (but this distinction may fade as more data become available). **Astrothelium confusum** is distinguished by having poorly carbonized ascomatal walls and is not yet known from Amazonia.

Distribution. Brazil, Malaya, Singapore and Borneo.

Specimens examined. AMAZONAS: Along Igarapé Caititu off Rio Uatumã, Buck 2810, 2926, 2930, 2993 (INPA, NY). RORAIMA: Along Manaus-Boa Vista Rd (BR 174) ca. 512 km from intersection of Manaus-Itacoatiara Rd, Buck [Dumont BR 638] (INPA, NY); 0-3 km S of central portion of Serra Aracá, Samuels 842A (INPA, NY).

**Astrothelium sulphureum** (Eschw.) Müll. Arg.

Mém. Soc. Phys. Hist. Nat. Genève 30: 7. 1888. **Pyrenastrum sulphureum** Eschw. in Mart., Icon. Pl. Cryptog. 17, pl. 8, f. 7. 1828. Holotype: Brazil, "ad arb. cortic. ad fluvium amazonum", Martius (M).

See discussion under **A. interjectum** and **A. subfuscum**. **Astrothelium sulphureum** is known only from the type and Spruce's collection.

Specimen examined. PARÁ: Óbidos, Spruce 243 (BM).

**Astrothelium variolosum** (Ach.) Müll. Arg.

Flora 68: 255. 1885. **Trypethelium variolosum** Ach., Synops. lich. 104. 1814. Type collection: "Amer. merid.". Isotypes? in BM & UPS.

**Verrucaria catervaria** Fée, Essai crypt. écorc. exot. off. 90. 1824. **Trypethelium**



**catervarium** (Fée) Müll. Arg. Lectotype (selected here): "ad corticem **Cinchonae lancifoliae**" ex hb. Fée (G), syn. nov.

**Astrothelium simplicatum** Vainio, Acta Soc. Fauna Fl. Fenn. 7(2): 194. 1890. Type collection: Brazil: Minas Gerais, Sítio, 1000 m, **Vainio 1006**. Isotypes in BM & M, syn. nov.

**Astrothelium variolosum** merges with **Trypethelium ochroleucum** as does its UV- counterpart, **A. confusum**, with **T. nitidiusculum**. These four taxa may represent aspects of a single highly variable species. See also under the discussion of **A. subfuscum**.

Distribution. Southern US, Bahamas, Cuba, Trinidad, French Guiana, Colombia, **Brazil** (Minas Gerais, Rio de Janeiro) and Bolivia.

Specimen examined. RORAIMA: Along Manaus-Boa Vista Rd (BR-174) ca. 345 km from intersection of Manaus-Itacoatiara Rd, **Buck [Dumont BR 481]** (INPA, NY).

### **Astrothelium versicolor** Müll. Arg.

Flora 71: 495. 1888. Holotype: Puerto Rico, **Sintenis 6** (G).

**Pseudopyrenia** (**Trypethelium**) **aureomaculata** Vainio, Acta Fauna Fl. Fenn. 7(2): 207. 1890. Type collection: Brazil, Minas Gerais, Caraça, **Vainio 1473**. Isotypes in BM & M, syn. nov.

Distribution. Florida, Bahamas, Cuba, Puerto Rico, Trinidad, French Guiana, Guyana, Brazil (Minas Gerais, Rio de Janeiro), Bolivia and the Philippines.

Specimen examined. AMAZONAS: Along Rio Negro at Temendui Lagoon, **Buck 2233** (INPA, NY).

### **CAMPYLOTHELIUM** Müll. Arg.

Flora 66: 245. 1883. Holotype: **C. puiggarii** Müll. Arg.

Several species of **Campylotheleium** are reported from Brazil but not from Amazonia. The type species is known only from the state of São Paulo. **Campylotheleium amylosporum** (Vainio) R. C. Harris (Bryologist 83: 7,9. 1980, N. Amer. distrib.) is probably pantropical/subtropical. **Campylotheleium cartilagineum** Vainio from Minas Gerais is a synonym of **Heufleria chlorogastrica** Müll. Arg. and probably best referred to **Laurera**.

### **CRYPTOTHELIUM** Massal.

Atti Istitut. Veneto ser. 3, 5: 335. 1860. Holotype: **Astrothelium sepultum** Mont.

**Heufleria** Trevis., Flora 44: 23. 1861. (non Trevis. 1853, = **Astrothelium**). Lectotype (Stizenberger, 1862): **Astrothelium sepultum** Mont.

### Key to Amazonian species of **Cryptothelium**

- 1. Spores 75-95 x 23-28 µm, with 14-16 transverse septa; ostiole and area adjacent orangish red, KOH+ purple ..... **C. amazonum**
- 1. Spores 100-130 x 25-30 µm, with 15-16 transverse septa; ostiole and area adjacent ruby red, KOH+ dark green ..... **C. rhodotitthon**

The most common species in the genus, *C. sepultrum* (Mont.) Massal., is known from Minas Gerais and French Guiana and should occur in Amazonia. It is distinguished by thallus and/or pseudostromata UV+ yellow and asci with only two spores.

***Cryptothelium amazonum* R. C. Harris sp. nov.**

*Cryptothelium* ostiolo et parietibus superioris ascomatum crystallis aurantiacis KOH+ purpurascens; sporis octonis, muriformibus, septis transversis 14-16, 75-95 x 23-28  $\mu$ m.

Holotype: Brazil: Amazonas, Reserva Biológica de Campina INPA-SUFRAMA, Buck [Dumont BR 107] (INPA). Isotype in NY.

Thallus light yellow green, shiny, weakly bullate-rugose, corticate with a well developed white medulla containing colorless crystals; UV-. Ascomata scattered, solitary, immersed to weakly emergent, with 3-4 main chambers which are incompletely subdivided. Ostioles in a raised brown papillae, papillae and upper part of ascomata with orange crystals, KOH+ red purple. Wall carbonized. Hymenium not inspersed. Spores 8/ascus, biseriate, muriform, with 15-17 transverse and 3-4 longitudinal rows of cells, fusiform, 75-95 x 23-28  $\mu$ m, IKI-. (Fig. 2).

*Cryptothelium amazonum* is distinguished by the KOH+ purple pigment in the pseudostromata and the 8-spored asci with relatively small spores. There are no obvious relatives in *Cryptothelium* but it may be related by its pigmentation to the *Astrothelium cinnamomeum* group by way of *A. subaequans* with large, submuriform spores.

***Cryptothelium rhodotitthon* R. C. Harris sp. nov.**

*Cryptothelium* papillae rubrae, KOH+ atrovirentibus sporis octonis, muriformibus, septis transversis 15-16, 100-130 x 25-30  $\mu$ m.

Holotype: Brazil: Roraima, along Manaus-Boa Vista Rd (BR-174) ca. 350 km from intersection of Manaus-Itacoatiara Rd, Buck [Dumont BR 596] (INPA). Isotype in NY.

Thallus thin with large irregular warts filled with colorless crystals, thin areas brownish, warty-rugose patches yellowish; UV-. Ascomata immersed in bark or thalline warts with only the nipple-like red ostiolar papillae visible (red pigment also surrounding upper part of the ascomata), KOH+ dark green, several chambered. Wall carbonized. Hymenium not inspersed. Spores 8/ascus, biseriate, muriform, with 16-17 transverse and 3-4 longitudinal rows of cells, fusiform, 100-130 x 25-30  $\mu$ m, IKI-. (Fig. 3).

The red ostiolar pigment reacting green with KOH is not known elsewhere in *Cryptothelium*. The only other member of the Trypetheliaceae with such a pigment is *Laurera sanguinaria* Malme from southern Mato Grosso. Otherwise *C. rhodotitthon* has no obvious relationships.

**EXILISEPTUM R. C. Harris gen. nov.**

Genus Trypetheliacearum *Astrothelium* affinis sed sporis 4-locularibus et submuriformibus, parietibus et septis tenuibus.

Type species: *Verrucaria ocellata* Leighton.

The characters of the thallus and ascoma would place *Exiliseptum ocellatum* in *Astrothelium* but the thin walled, submuriform spores would be anomalous. The nature of spores suggests either *Polymeridium* or *Pleurotrema* but the well developed thallus would be out of place in both. *Exiliseptum* seems closest to *Pleurotrema acrophaeum* which also has an astrothelioid type of ascoma, but I prefer to restrict *Pleurotrema* to species with small 3-celled spores. *Exiliseptum* can be considered an intermediate evolutionary stage between *Astrothelium* and *Pleurotrema*. The genus is monotypic.

*Exiliseptum ocellatum* (Müll. Arg.) R. C. Harris comb. nov.

*Verrucaria ocellata* Leighton, Trans. Linn. Soc. Lond. 35: 458, pl. 56, f. 23. 1866 nom. illeg. (non Hoffman, 1790). *Polyblastia ocellata* Müll. Arg., Flora 65: 402. 1882. *Polyblastiopsis ocellata* (Müll. Arg.) Zahlbr. Type collection: Brazil: Amazonas, São Gabriel, Spruce 244. Isotype in BM.

Thallus olive green, shiny, corticate with a white medulla containing colorless crystals; UV-; whitish around ostioles, UV+ yellow (lichexanthone, not verified by TLC). Ascomata scattered, solitary, immersed. Wall carbonized. Hymenium not interspersed. Spores 8/ascus, uniseriate, with 4 transverse cells, 1-2 cells longitudinally divided, ovoid, 15-16 x 6-8 µm, IKI-; lateral walls and septa not thickened. (Fig. 6).

#### LAURERA Reichenb.

Deut. Bot. Herb.-Buch 15. 1841. nom. nov. pro *Meissneria* Fée, Essai crypt. écorc. exot. off. 2: 66. 1837. Holotype: *Meissneria varia* Fée nom. illeg. (Art. 63.2).

*Bathelium* Trevis., Flora 44: 21. 1861 nom. illeg. (non Ach., 1803) et nom. illeg. (Art. 63). Holotype: *Meissneria varia* Fée.

*Meristosporum* Massal., Atti Istitut. Veneto ser. 3, 5: 327. 1860. Holotype: *M. javanicum* Massal. (= *Trypethelium meristosporum* Mont. & v. d. Bosch in Junghuhn).

*Laureromyces* Cif. & Tom., Ist. Bot. Reale Univ. Reale Lab. Crittog. Pavia Atti ser. 5, 10: 34,62. 1953. Holotype *L. gigantospora* Cif. & Tom.

*Melanothecomycetes* Cif. & Tom., Ist. Bot. Reale Univ. Reale Lab. Crittog. Pavia Atti ser. 5, 10: 35,62. 1953. Holotype: *M. javanica* Cif. & Tom.

*Riddlea* Dodge, Ann. Missouri Bot. Gard. 40: 287. 1953. Holotype: *R. papillosa* Dodge, syn. nov.

Letrouit-Galinou's (1957, 1958) survey of *Laurera* is still adequate for the Neotropical species but in Southeast Asia (which seems to be the center of diversity) there are 10-20 undescribed species. The only change besides the addition of *L. aurata* sp. nov. for the Neotropics is that *Laurera dodgei* Letr.-G. is antedated by *Bottaria subdisjuncta* Müll. Arg. (Bot. Jahrb. Syst. 6: 395. 1885), *Laurera subdisjuncta* (Müll. Arg.) R. C. Harris comb. nov.

*Riddlea* Dodge is based on a specimen of some species in the *Laurera marginata* group without mature spores and thus cannot be placed precisely.

Key to Amazonian species of *Laurera*

1. Thallus and/or ascomata with bright scarlet pigment; spores 8/ascus 110-160 x 15-25  $\mu\text{m}$ , with ca. 40-45 transverse septa, IKI+ violet; hymenium not inspersioned.....  
..... *L. purpurina*
1. Thallus and ascomata not bright scarlet ..... 2
2. Pseudostromata externally orange pigmented, KOH+ purple; spores 8/ascus, ca. 250 x 20-30  $\mu\text{m}$ , ca. 35 transverse septa, IKI+ violet; hymenium not inspersioned .....  
..... *L. aurata*
2. Pseudostromata brown or concolorous with the thallus; hymenium inspersioned; spores IKI- ..... 3
3. Spores 4/ascus, 200-270 x 30-40  $\mu\text{m}$ , with 50-70 transverse septa; ascomata most ly solitary, covered by thallus; medulla filled with white crystals .....  
..... *L. megasperma*
3. Spores 8/ascus, 45-75 x 15-22  $\mu\text{m}$ , with 12-17 transverse septa; ascomata aggregated in irregular, brown pseudostromata with an internal layer of orange crystals, KOH+ purple red ..... *L. madreporiformis*

*Laurera aurata* R. C. Harris sp. nov.

*Laurera pseudostromatibus* aureis, KOH+ rubris; sporis octonis, magnis, septis transversis ca. 35, ca. 250 x 20-30  $\mu\text{m}$ , IKI violascentibus.

Holotype: Brazil: Acre, km 12 BR-364 on road to Porto Velho, Lowy 961 BR (INPA).  
Isotype in NY.

Thallus pale greenish tan, smooth, weakly corticate without an obvious medulla; UV-. Ascomata aggregated in circular to short irregular raised pseudostromata which may be somewhat constricted at the base, orange pigmented, KOH+ purple red. Wall carbonized. Hymenium not inspersioned. Spores 8/ascus, irregularly arranged, sigmoid, muriform with ca. 36 transverse and 5-6 longitudinal rows of cells, ca. 250 x 20-30  $\mu\text{m}$ , IKI+ violet. (Fig. 7).

*Laurera aurata* is not clearly related to any other species of *Laurera*. The only other 8-spored species with very large spores is *L. meristospora* (Mont. & v.d. Bosch) Zahlbr. from Asia which lacks pseudostromatal pigments. *Laurera gigantospora* (Müll. Arg.) Zahlbr. and *L. megasperma* have equally large spores but have 2- or 4-spored a $\text{sc}$ i and also lack pigments.

*Laurera madreporiformis* (Eschw.) Riddle

in Howe, *Torreyia* 16: 50. 1916. *Trypethelium madreporiforme* Eschw., Syst. lich. 24, f. 24a-c. 1824. Lectotype (selected here): Brazil: Serra dos Montes altos, Martius (M).

This species is apparently endemic to the Neotropics but there are several very closely related species in Africa differing only in spore size. Since the diversity is in Africa it seems possible that *L. madreporiformis* represents an African element in

the Neotropical flora. Its distribution is also noteworthy in that *L. madreporiformis* is apparently absent from the West Indies.

Distribution. Southern US, Mexico, French Guiana, Colombia, Venezuela, Brazil (Bahia, Mato Grosso, Pernambuco) and Bolivia.

Specimens examined. MATO GROSSO: Serra do Roncador, 46 km N of Chavantina, Rio Vau, **Prance & Silva 59380E** (INPA, NY). PARÁ: Pará (Belém), Carissi, 1849, **Spruce** (BM); Santarém **Spruce 235, 255** (BM).

**Laurera megasperma** (Mont.) Riddle

Bull. Torrey Bot. Club 44: 323. 1917. *Trypethelium megaspermum* Mont., Ann. Sci. Nat. Bot. sér. 2, 19: 68. 1843. Type collection: French Guiana, **Leprieur 603**. Isotype in FH-Tayl III.

*Trypethelium ostendatum* Krempelh., Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn 5: 398, pl. 1, f. 22. 1874. *Laurera ostendata* (Krempelh.) Zahlbr. Holotype: Brazil: Minas Gerais, Serra d' Estrella, **Warming 79** (M).

*Campylothelium nitidum* Zahlbr., Ann. Mycol. 33: 39. 1935 (non Müll. Arg., 1891). = *Campylothelium zahlbruckneri* R.-G. Werner nom. nov. Holotype: Florida, Sanford, **Rapp 84** (W), syn. nov.

Distribution. Florida, Cuba, Jamaica, Puerto Rico, French Guiana, Brazil (Minas Gerais, Sta. Catarina) and Ceylon.

**Laurera purpurina** (Nyl. ex Leighton) Zahlbr.

Akad. Wiss. Wien Math.-Naturwiss. Kl., Denkschr. 83: 93. 1909. *Trypethelium purpurinum* Nyl. ex Leighton, Trans. Linn. Soc. Lond. 25: 459, pl. 56, f. 6. 1866. Lectotype (selected here): Brazil: Pará, Santarém, **Spruce 236** (BM ex K). Isotype in BM.

The red pigment of this species is one of the purest reds among the fungi. Brian Boom (pers. comm.) found the Chacobo Indians of Bolivia drink a decoction of *L. purpurina* to alleviate headaches. This is the only medicinal use reported for any member of the family.

Distribution. Bolivia, Africa and Sri Lanka.

Specimens examined. PARÁ: Santarém, **Spruce 187, 236** (BM). RORAIMA: ca. 29 km N of Boa Vista, **Buck: [Dumont BR 696]** (INPA, NY).

**PLEUROTREMA** Müll. Arg.

Bot. Jahrb. Syst. 6: 388. 1885. Lectotype (Clements, 1909): *Parathelium polysemum* Nyl.

*Pleurotrematomyces* Cif. & Tom., Ist. Bot. Reale Univ. Reale Lab. Crittog. Pavia Atti ser. 5, 14: 6. 1957. Holotype: *P. polysemi* Cif. & Tom.

When Müller described *Pleurotrema* he included two species, *P. inspersum* Müll. Arg. and *P. polysemum* (Nyl.) Müll. Arg. Clements (1909) typified the genus with *P. polysemum* and described *Ditremsis* for *P. inspersum*. In my thesis (Harris, 1975) I indicated a preference for reversing the typification since the two species are not congeneric and the

the bulk of the species are allied with *P. inspersum*, thus requiring fewer name changes. However, Eriksson (1981) has accepted Clement's typification and since neither genus has any history of usage, I am content to follow Eriksson. *Ditremis* is referred to the Strigulaceae or Acrocordiaceae (if one wishes to recognize the latter as a distinct family). Eriksson placed *Pleurotrema polysemum* in the Pyrenulaceae but on the basis of the hymenium, spores and microconidia. I feel it is best considered a reduced member of the Trypetheliaceae in a delichenizing line analogous to that of *Pseudopyrenula* and *Polymeridium*. It could have its origin in something like *Exiliseptum ocellatum* with *Pleurotrema acrophaeum* (Müll. Arg.) R. C. Harris comb. nov. (*Astrothelium acrophaeum* Müll. Arg., Bot. Jahrb. Syst. 6: 383. 1885.) representing a possible intermediate stage.

*Pleurotrema acrophaeum* differs from *P. polysemum* only in having a compound ascoma which in this case, as in others, e. g., *Polymeridium biloulaire*, I do not consider to be a generic distinction. Neither species has been reported from Brazil and both are known only from their types, *P. polysemum* from Colombia and *P. acrophaeum* from Cuba.

**POLYMERIDIUM** (Müll. Arg.) R. C. Harris

In Tucker & Harris, Bryologist 83: 12. 1980. *Arthopyrenia* sect. *Polymeridium* Müll., Flora 46: 317. 1883. Lectotype (Riedl, 1962): *Verrucaria contendens* Nyl.

These species have mostly been placed in *Arthopyrenia* Massal. but the hamathecium is identical to that in *Trypethelium* (including the same type of oily granular inspersion), the microconidia are identical, lichexanthone is often present and post mature spores have thickened walls. The thallus is very much reduced and some species apparently are not lichen-forming.

*Pseudopyrenula*, which has a similarly reduced thallus and ascoma but retains the *Trypethelium* spore type, seems to represent an intermediate stage in the evolution from *Trypethelium*. Some *Trypethelium* species show tendencies which also point in this direction: *T. tropicum* with  $\pm$  naked ascomata or *T. violascens* with thin walled spores.

Key to Amazonian species of *Polymeridium*

- 1. Spores 10-12-celled, 37-47 x 9-11  $\mu$ m; hymenium heavily inspersed; thallus UV+ yellow ..... *P. pleiomeroideis*
- 1. Spores 4-celled, mostly less than 30  $\mu$ m long; hymenium not inspersed ..... 2
  - 2. Thallus UV-; ascomata of two chambers with a common ostiole; spores 26-30 x 8-10  $\mu$ m ..... *P. biloulaire*
  - 2. Thallus UV+ yellow; ascomata with only a single chamber ..... 3
    - 3. Spores 24-33 x 8-10  $\mu$ m ..... *P. catapastum*
    - 3. Spores 20-25 x 6-7.5  $\mu$ m ..... *P. albidum*

*Polymeridium albidum* (Müll. Arg.) R. C. Harris comb. nov.

*Arthopyrenia albida* Müll. Arg., Flora 67: 664. 1884. Lectotype (selected here): Brazil: Bahia, Caetitê, Martius (M).

In my notes on the type specimen I did not record any UV reaction and this needs to be rechecked. The Amazonian collections are otherwise identical to the type.

Distribution. Southern US.

Specimens examined. AMAZONAS: Reserva Biológica de Campina INPA-SUFRAMA, Buck [Dumont BR 106] (INPA, NY). RORAIMA: Along Manaus-Boa Vista Rd (BR-174) ca. 345 km from intersection of Manaus-Itacoatiara Rd, Buck [Dumont BR 472] (INPA, NY).

*Polymeridium biloculare* R. C. Harris sp. nov.

Similis *P. catapasto* sed thallo UV- et ascomatibus bilocularibus. Holotype: Brazil: Roraima, along Manaus-Boa Vista Rd (BR-174) ca. 350 km from intersection of Manaus-Itacoatiara Rd, Buck [Dumont BR 594] (INPA). Isotype in NY.

Thallus indicated by a gray discoloration of bark, UV-. *Trentepohlia* present but not abundant. Ascomata immersed, with 2 chambers joined by a common ostiole. Carbonized wall lacking at base. Hymenium not inspersed. Spores 8/ascus, biseriata, 4-celled, constricted at the septa, fusiform, 26-30 x 8-10  $\mu$ m, IKI-, with a prominent gelatinous sheath. (Fig. 8).

Multilocular ascomata seem to occur sporadically in otherwise unilocular genera, e.g., *Pleurotrema acrophaeum* and *Strigula connivens* ined. While I do regard this as a specific character, even if one were not to, there does not seem to be any unilocular species with this combination of spore size, lack of UV reaction and lack of hymenial inspersation.

*Polymeridium catapastum* (Nyl.) R. C. Harris comb. nov.

*Verrucaria catapasta* Nyl., Acta Soc. Sci. Fenn. 7: 488. 1863. Type collection: Colombia, Bogota, 2600 m, ad quercum, Lindig 2869. Isotypes in BM & FH-Tuck 4086.

*Pyrenastrum album*, *verrucarioides* Eschw. in Mart., Fl. Bras. 1: 147. 1833. *Arthopyrenia tumida* Müll. Arg., Flora 67: 669. 1884. Lectotype (selected here): Brazil, Bahia, near Bahia, Martius (G).

Distribution. Southern US, Bahamas, Cuba, Colombia, Venezuela and Brazil (Bahia).

Specimen examined. RORAIMA: Along Manaus-Boa Vista Rd (BR-174) ca. 350 km from intersection of Manaus-Itacoatiara Rd, Buck [Dumont BR 599A] (INPA, NY).

*Polymeridium pleiomeroides* (Müll. Arg.) R. C. Harris comb. nov.

*Arthopyrenia* (s. *Polymeridium*) *pleiomeroides* Müll. Arg., Bot. Jahrb. Syst. 6: 407. 1885. Holotype: Cuba, Wright Verr. Cub. 76 (G).

The Amazonian collection is the only one known other than the type.

Specimen examined. AMAZONAS: Along Igarapé Caititu off Rio Uatumã at Antônio Filinto, Buck 2980A (INPA, NY).

*PSEUDOPYRENULA* Müll. Arg.

Flora 66: 247. 1883. Lectotype (Clements, 1909): *Verrucaria diluta* Fée.

**Plagiotrema** Müll. Arg., Bot. Jahrb. Syst. 6: 387. 1885. Holotype: *P. cubanum* Müll. Arg. (= *Pseudopyrenula subgregaria* Müll. Arg.).

This genus has not yet been seen from Amazonia but two species are common in drier regions of Brazil, *P. diremta* (Nyl.) Müll. Arg. and *P. subgregaria* Müll. Arg. Both have heavily inspersed hymenia and often a yellowish hymenial pigment which is red in KOH. *Pseudopyrenula subgregaria* has spores 20-27 x 6-8 µm and *P. diremta* 27-35 x 8-9 µm.

#### TRYPETHELIUM Sprengel

Anleitung Kenntn. Gewächse 3: 350. 1804. nom. cons. (syn. prius *Bathelium* Ach. Meth. lich. III. 1803). Holotype: *T. eluteriae* Sprengel.

*Trypetheliomyces* Cif. & Tom., Ist. Bot. Reale Univ. Reale Lab. Crittog. Pavia Atti ser. 5, 10: 35, 62. 1953. Holotype: *T. virentis* Cif. & Tom.

#### Key to Amazonian species of *Trypethelium*

1. Spores more than 10-celled; pseudostromata usually raised, circular to irregular, often constricted at the base, contents KOH+ purple ..... 2
2. Spores 10-14-celled, 40-50 x 9-12 µm; powder in pseudostromata various shades of yellow to tan, often with a greenish tint; pseudostromata and/or thallus often heavily pruinose ..... *T. eluteriae*
2. Spores 13-16-celled, 60-75(-85) x 11-12 µm; powder in pseudostromata orange; pseudostromata orange to brown, not pruinose ..... *Trypethelium* sp. aff. *eluteriae*
1. Spores 4-celled ..... 3
3. Thallus UV+ yellow ..... 4
3. Thallus UV- ..... 5
4. Pseudostromata externally orange pigmented, KOH+ purple; spores 18-23 x 7-8 µm; hymenium not inspersed ..... *T. neogalbineum*
4. Pseudostromata not pigmented, immersed to raised, concolorous or paler than thallus or ascomata immersed and not obviously aggregated in pseudostromata; spores 20-25 x 7.5-10 µm; hymenium inspersed or not; wall sometimes not carbonized, often with numerous colorless crystals.....*T. ochroleucum*
5. Thallus and pseudostromata orange, KOH+ purple; ascomata scattered or aggregated into immersed groups or rarely in raised pseudostromata; wall often not carbonized, sometimes with numerous colorless crystals; hymenium inspersed or not; spores 21-28 x 8-9 µm ..... *T. aeneum*
5. Thallus not orange, KOH- ..... 6
- 6 Internal layers of pseudostromata KOH+ red, bleeding into solution (check cross-section under microscope). ..... 7
7. Spores violet in IKI, 28-33 x 8-10 µm, thin walled; ascomata solitary or few closely aggregated; orange pigment in wall not very evident; hymenium not inspersed ..... *T. violascens*
7. Spores remaining colorless in IKI, thick walled ..... 8



8. Spores 33-47 x 14-16  $\mu\text{m}$ ; ascomata solitary, immersed or in  $\pm$  raised small pseudostromata concolorous or paler than the thallus; hymenium inspersion or not ..... **T. buckii**
8. Spores 20-27 x 8-9  $\mu\text{m}$ ; pseudostromata brown to blackish, often not much raised; pigment yellow to orange; hymenium not inspersion ..... **T. degenerans**
6. Internal layers of pseudostromata KOH- ..... 9
9. Ascomata black, not included in pseudostromata or covered by thallus; hymenium inspersion; spores 20-26 x 6-8  $\mu\text{m}$  ..... **T. tropicum**
9. Ascomata immersed in thallus or included in pseudostromata ..... 10
10. Spores 48-65 x 17-20  $\mu\text{m}$ ; thallus very thick, bullate-rugose with very thick crystal filled medulla; ascomata scattered, immersed; ostiole surrounded by a whitish ring; hymenium not inspersion ..... **T. tuberculosum**
10. Spores 20-27 x 8-10  $\mu\text{m}$ ; thallus thin,  $\pm$  smooth; ascomata usually solitary and scattered but sometimes aggregated in raised pseudostromata; wall often not carbonized, often filled with colorless crystals; hymenium inspersion or not... **T. nitidiusculum**

**Trypethelium aeneum** (Eschw.) Zahlbr.

in Engler & Prantl, Nat. Pflanzenfam. 1(1\*): 70. 1903. **Verrucaria aenea** Eschw. in Mart., Icon. Pl. Cryptog. 15, pl. 8, f. 3. 1828. Holotype: Brazil, Bahia, Caetité, **Martius** (M).

Distribution. Florida, Bahamas, Cuba, Jamaica, French Guiana, Colombia, Venezuela, Brazil (Minas Gerais, Mato Grosso, Rio de Janeiro), Bolivia, Sri Lanka and Borneo.

Specimens examined. AMAZONAS: Along E shore of Rio Uatumã just downstream from Cachoeira do Tucumã, **Buck 3076** (INPA, NY); Reserva Biológica de Campina INPA-SUFRAMA, **Buck [Dumont BR 104]** (INPA, NY); Plateau of Serra Aracã, **Samuels 535** (INPA, NY). MARANHÃO: 40 km S of Loreto, **Eiten & Eiten** (NY). MATO GROSSO: Serra do Roncador, 46 km N of Chavantina, Rio Vau, **Prance & Silva 59380D** (INPA, NY); Fazenda Patizal, São Felix, **Richards 6546** (BM). RORAIMA: Along Manaus-Boa Vista Rd (BR-174) ca. 350 km from intersection of Manaus-Itacoatiara Rd, **Buck [Dumont BR 597]** (INPA, NY).

**Trypethelium buckii** R. C. Harris sp. nov.

**Trypethelium** ascomatibus circumcinctis strato ferrugineo KOH+ purpureo, hymenio insperso et sporis 4-ocularibus, 33-47 x 14-16  $\mu\text{m}$ .

Holotype: Brazil: Amazonas, along Rio Negro at high water, ca. 100 km NW of Manaus at Paranã Conceição and P. Tauatú, 02°30'S, 61°00'W, **Buck 2157** (INPA). Isotype in NY.

Thallus shades of green, shiny, varying in thickness, corticate with a white medulla filled with colorless crystals or sometimes lacking, smooth or sometimes apparently causing hypertrophy in the host giving a bullate-rugose aspect; UV-. Ascomata scat

tered and solitary to aggregated in small roundish raised pseudostromata, immersed or emergent, with an orangish brown layer just outside the carbonized wall, KOH+ red. Ostioles surrounded by a whitish ring. Hymenium inspersion (in type) or not. Spores 8/ascus, biseriolate, 4-celled, fusiform, 33-47 x 14-16 µm, IKI-. (Fig. 10).

*Trypethelium buckii* is a member of the *T. annulare* group which has two series of spore variants, one with the KOH+ red pigment surrounding the ascumata and the other without. *Trypethelium thelotremoides* (Nyl.) R. C. Harris comb. nov. (*Verrucaria thelotremoides* Nyl., Ann. Sci. Nat. Bot. sér. 5, 7: 346. 1867) is the large spored (50-65 µm) member of the KOH+ series. The small spored one has not been found yet. The KOH-series includes *T. annulare* (Fée) Mont. (62-80 µm), *T. tuberosum* (48-65 µm) and *T. floridanum* (Zahlbr. ex Choisy) R. C. Harris comb. nov. (*Astrothelium floridanum* Zahlbr. ex Choisy, Icon. Lich. Univ. pl. 5. 1928) (36-46 µm).

The type specimen of *T. buckii* and a few others have an inspersion hymenium, others do not. There are no other differences and the distribution and ecology are apparently identical.

Specimens examined. (hymenium inspersion) BRAZIL, MATO GROSSO: Serra do Roncador, Richards 6374 (BM). FRENCH GUIANA: sine loc., Leprieur 162 (BM, FH-Tuck 3969). VENEZUELA, AMAZONAS: San Carlos, Spruce 244 (BM). (hymenium not inspersion) BRAZIL, AMAZONAS: Along Rio Negro at Temendui Lagoon, Buck 2243 (INPA, NY); 62-67 km W of Humaitã on Trans-Amazon Hwy, Fife 4291 (INPA, NY). TRINIDAD: Aripo Savanna, 1912-13 Thaxter (FH). VENEZUELA, AMAZONAS: near Culebra, Guariglia 1486 (NY, VEN); San Carlos, Spruce 248 (BM).

#### *Trypethelium degenerans* (Vainio) Zahlbr.

Cat. Lich. Univ. 1: 490. 1922. *Pseudopyrenula* (*Trypethelium*) *degenerans* Vainio, J. Bot. 34: 292. 1896. Holotype: Dominica, Laudat, 1700 ft., Eliot 912 (TUR-Vainio 30782). Isotype in BM.

Distribution. Jamaica, Puerto Rico, Dominica, Mexico, Venezuela.

Specimen examined. PARÁ: Santarém, Spruce 256 (BM).

#### *Trypethelium eluteriae* Sprengel

Anleitung Kennzn. Gewächse 3: 351. 1804. Type collection not seen ("auth. spec. ex hb. Carl Sprengel" Herb. van den Bosch, FH-Tuck 3974).

*Trypethelium sprengelii* Ach., Lich. Univ. 306, pl. 4, f. 8. 1810. Type collection not seen: "Ad corticem Clutiae Eluteriae, Sprengel, in Quassia Surinami, Swartz". Authentic material? in BM ex K.

*Astrothelium varium* Eschw. in Mart., Fl. Bras. 1: 161. 1833. Lectotype (selected here): Brazil, Martius (M).

*Astrothelium varium, citrinum* Eschw. in Mart., Fl. Bras. 1: 162. 1833.

*Trypethelium sprengelii* var. *citrinum* (Eschw.) Müll. Arg. Lectotype (selected here): Brazil, Martius (M).

*Trypethelium luteum* Taylor, Lond. J. Bot. 6: 157. 1847. Holotype: India, Madras, Wight (FH-Tayl 109). Isotypes in BM, syn. nov.

**Trypethelium assimile** Stirton, Proc. Roy. Philos. Soc. Glasgow 13: 193. 1881. Type collection: Assam, **Watt**. Isotype in BM, syn. nov.

**Thyridaria crocosarca** Cooke, Grevillea 20(95): 83. 1892. Type collection: Ceylon, **Thwaites 131** (not seen), syn. nov.

**Trypethelium pringlei** Eckf., Bull. Torrey Bot. Club 21: 395. 1894. Type collection: Mexico, San Luis Potosi, Las Palmas, 6.VI.1890, **Pringle 226**. Isotype in FH, MICH & US, syn. nov.

**Trypethelium scitulens** Eckf., Bull. Torrey Bot. Club 21: 395. 1894. Type collection: Mexico, San Luis Potosi, Las Palmas, 6.VI.1890, **Pringle 200**. Isotypes in FH., syn. nov.

**Pseudopyrenula (Trypethelium) subsulphurea** Vainio, Acta Fauna Fl. Fenn.7(2): 205. 1890. **Trypethelium subsulphureum** (Vainio) Zahlbr. Type collection: Brazil, Rio de Janeiro, Sepitiba, **Vainio 413**. Isotypes in BM & M, syn. nov.

**Trypethelium (sect. Eutrypethelium) leprosum** Zahlbr., Ann. Mycol. 30: 499. 1932. Syntype collections: China, prov. Fukien, Kulang prope Fudschou, **Chung 371** & **376**. Isosyntypes in FH, syn. nov.

This is one of the commonest lowland pantropical lichens. It is highly variable in color of thallus and pseudostromatal pigments as evidenced by the lengthy synonymy.

Specimen examined. PARÁ: Pará (Belém), 1849, **Spruce** (BM, M).

#### **Trypethelium sp. aff. eluteriae**

I am not describing this species formally as there are a number of old names in this group whose types have not been examined. It is highly probable that at least one of them will prove to be this species as it is quite common with a range similar to that of **T. eluteriae** s. str. The orange pigment, lack of pruina and larger spores distinguish it from **T. eluteriae**.

Distribution. Florida, Cuba, Puerto Rico, Brazil (Mato Grosso), Bolivia, Africa, India, Sri Lanka, Malacca, Philippines and Queensland.

Specimen examined. PARÁ: Pará (Belém), 1849, **Spruce** (BM)

#### **Trypethelium neogalbineum** R. C. Harris sp. nov.

**Trypethelium** thallo UV+ aureo, pseudostromatibus aurantiacis KOH+ purpureis hymenio non insperso et sporis 4-ocularibus, 18-23 x 7-8  $\mu$ m.

Holotype: Brazil, Pará, Santarém, **Spruce 259** (BM ex K, hb. Leighton as **Verrucaria heterochroa**). Isotypes in BM.

Thallus buff, relatively thin, corticate with a thin white medulla; UV+ yellow (lichexanthone, not verified by TLC). Ascomata aggregated in long chain-like, interconnected, slightly raised pseudostromata which are externally orange pigmented, KOH+ purple. Wall carbonized. Hymenium not inspersed. Spores 8/ascus, biseriate, 4-celled, fusiform, 18-23 x 7-8  $\mu$ m, IKI-. (Fig. 9).

**Trypethelium neogalbineum** is named with reference to **Astrothelium galbineum** which it greatly resembles except that the ascomata are unilocular in the former, multilocular

in the latter. At this time I do not care to speculate which represents the ancestral type. I do wish to emphasize that I consider them closely related and exemplify the unnatural character of the genera in the Trypetheliaceae.

**Trypethelium nitidiusculum** (Nyl.) R. C. Harris comb. nov.

**Verrucaria nitidiuscula** Nyl. Ann. Sci. Nat. Bot. sér. 4. 20: 252. 1863. Type collection: Colombia, Villeta, 1200-2000 m, Lindig 2829. Isotypes in FH-Tuck 3970 & M.

**Trypethelium catervarium** var. **rufescens** Müll. Arg., Bot. Jahrb. Syst. 6: 391. 1885. Type collection: Cuba, Wright Verr. Cub. II. 576. Isotype in FH-Tuck 3970, syn. nov.

**Astrophyrenia minutissima** Vainio, Acta Fauna Fl. Fenn. 7(2): 234. 1890. Type collection: Brazil, Minas Gerais, Lafayette, Vainio 323. Isotypes in BM, syn. nov.

This species has generally been known as **T. catervarium** but the type of that species has proved to be **Astrothelium variolosum**. **Trypethelium nitidiusculum** is the lichexanthone lacking counterpart of **T. ochroleucum** and the unilocular ascomatal pair of **Astrothelium confusum** Müll. Arg. **Trypethelium subcatervarium** Malme is similar but has larger spores and its thallus reacts reddish with KOH.

Distribution. Southern US, Bermuda, Bahamas, Cuba, Jamaica, Dominican Republic, Trinidad, French Guiana, Colombia, Venezuela, Brazil (Mato Grosso, Minas Gerais, Rio de Janeiro), Paraguay, Africa and Sri Lanka.

Specimens examined. AMAZONAS: Along Igarapé Caititu off Rio Uatumã, Buck 2954, 2980 (INPA, NY). PARÁ: Pará (Belém), Carissi, 1849, Spruce (BM).

**Trypethelium ochroleucum** (Eschw.) Nyl.

Flora 52: 126. 1869. **Verrucaria ochroleuca** Eschw. in Mart., Icon. Pl. Cryptog. 16, pl. 8, f. 3-4. 1828. Lectotype (selected here): Brazil, Bahia, Caetité, Martius (M, with holotype of **T. aeneum**).

**Trypethelium pallescens** Fée, Ann. Sci. Nat. 23: 440, pl. 13, f. 3A-C. 1831. Lectotype (Müll. Arg., 1888): "Surinam ad corticem arboris ignotae". (G). Isolectotype in G.

**Trypethelium erubescens** Kunze ex Fée, Ann. Sci. Nat. 23: 441, pl. 14, f. 1. 1831. Lectotype (selected here): "Surinam ad corticem arboris ignotae". (G, with isolectotype of **T. pallescens**).

**Verrucaria diffluens** Nyl., Ann. Sci. Nat. Bot. sér. 4, 20: 252. 1863.

**Pseudopyrenula diffluens** (Nyl.) Müll. Arg. Type collection: Colombia, Bogota, 2600 m. Lindig 2770. Isotypes in BM, FH-Tuck 3970 & M), syn. nov.

**Trypethelium euporum** Krempelh., Flora 59: 527. 1876. Holotype: Brazil, Prov. Rio de Janeiro, Glaziou 6304 (M), syn. nov.

**Trypethelium ochroleucum** var. **depauperatum** Müll. Arg., Bot. Jahrb. Syst. 6: 392. 1885. Isosyntype: Cuba, Wright Verr. Cub. II. 571 (US).

**Astrothelium simplicatum** Vainio, Acta Fauna Fl. Fenn. 7(2): 194. 1890. Type collection: Brazil, Minas Gerais, Sítio, Vainio 1006. Isotype in M, syn. nov.

**Trypethelium tricolor** Müll. Arg., Bull. Soc. Bot. Belg. 32: 166. 1893. Type collection: Costa Rica, Boruca, **Pittier 6282**. Isotype in US, syn. nov.

**Pseudopyrenula portoricensis** Hedrick, Mycologia 22: 24. 1930. Holotype: Puerto Rico, near Mayaguez, 16.XII.1915 **Fink 1025** (MICH), syn. nov.

**Trypethelium ochroleucum** is one of the more common and variable members of the family. It intergrades with **Astrothelium variolosum**. See also under the discussion of **T. nitidiusculum**.

Distribution. Southern US, Bahamas, Cuba, Jamaica, Puerto Rico, Trinidad, Tobago, Mexico, Costa Rica, French Guiana, Colombia, Venezuela, Brazil (Bahia, Mato Grosso, Minas Gerais, Rio de Janeiro, São Paulo), Paraguay, Africa, India and Sri Lanka.

Specimens seen. AMAZONAS: Along Igarapé Santa Luzia just off Rio Uatumã, **Buck 2891** (INPA, NY). PARÁ: Serra do Cachimbo, Base Aérea do Cachimbo, **Brako 5800B** (INPA, NY).

**Trypethelium tropicum** (Ach.) Müll. Arg.

Bot. Jahrb. Syst. 6: 393. 1885. **Verrucaria tropica** Ach., Lich. Univ. 278. 1810. Type collection: "...in Insulis tropicis Americae. Swartz". Isotypes? in BM & S.

**Verrucaria tristis** Hepp in Zoll., Syst. Verzeichn. Ind. Archip. Ges. Pfl. 8, f. 5, l. 1854. Isosyntype: Java, ad ramos pr. Tjikoya, Zollinger (M).

**Zignoella magnoliae** Tracy & Earle, Bull. Torrey Bot. Club 23: 211. 1896. Holotype: Mississippi, Ocean Springs, 7.III.1896, **Tracy** (NY), syn. nov.

**Zignoella lichenoidea** v. Höhnelt, Sitzungsber. Kaiserl. Akad. Wiss. Math.-Naturwiss. Cl., Abt. 1, 118: 331. 1909. Type collection: Java, Buitenzorg Botanical Garden, on **Albizia moluccana**, v. Höhnelt, distr. in Rehm, Ascomyceten 1862. Isotypes in BPI & NY), syn. nov.

**Pseudopyrenula verrucosa** Vainio, Ann. Acad. Sci. Fenn., Ser. A, 6(7): 198. 1915. Holotype: Ad corticem Syagri **coccodis** prope Camp Jacob in Guadeloupa, **Duss 1394** (TUR-Vainio 30797).

**Zignoella (Trematostoma) nobilis** Rehm, Leaf!. Philipp. Bot. 8: 2950. 1916. Type collection: Philippines, Luzon, Prov. Laguna, Mount Maquiling, on **Citrus nobilis**, V. 1914, **Baker**, distr. as Baker, Fungi Malayana 200. Isotypes in BPI & NY, syn. nov.

**Pseudopyrenula deightonii** Dodge, Ann. Missouri Bot. Gard. 40: 279. 1953. Type collection: Sierra Leone, Njala (Kori), on **Peltophorum africanum** v. **speciosum**, **Deighton M4340**. Isotype in BM, syn. nov.

This species has the thallus of a **Trypethelium** and the ascomata of a **Pseudopyrenula**. This led Vainio to unite the genera. I prefer to maintain both and to include **T. tropicum** in **Trypethelium**. To some extent this further emphasizes the artificial nature of the genera. **Trypethelium tropicum** is pantropical and very common.

Specimen examined. PARÁ: Pará (Belém), 1849, **Spruce** (BM. M).

**Trypethelium tuberculosum** (Vainio) R. C. Harris stat. & comb. nov.

**Pseudopyrenula annularis** var. **tuberculosa** Vainio, Ann. Acad. Sci. Fenn., ser. A,

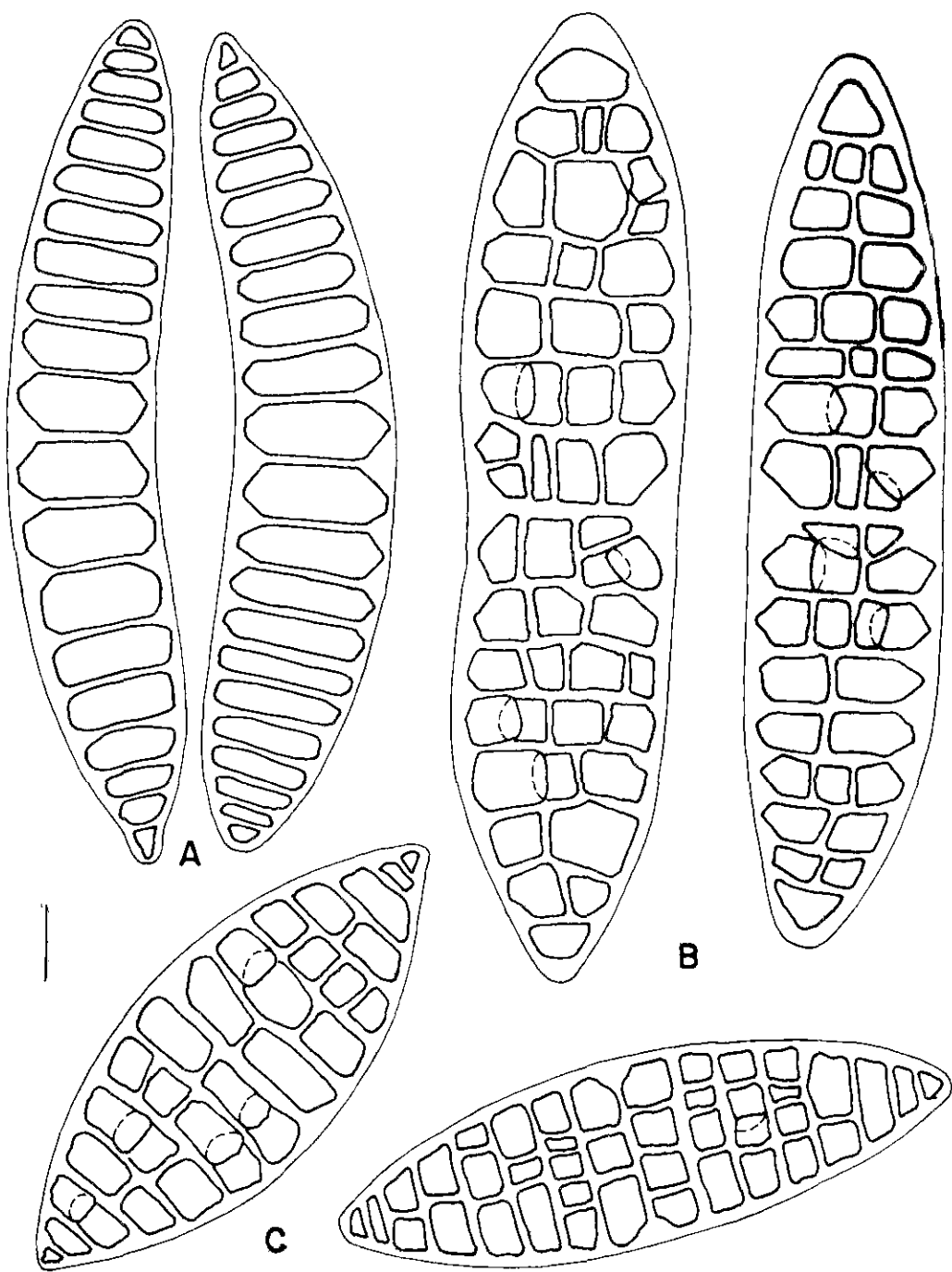


Fig. 1. Spores (all drawn from type collections). Bar = 10  $\mu$ m. A. *Astrothelium gigasporum*; B. *Cryptothelium amazonum*; C. *Cryptothelium rhodotitthon*.

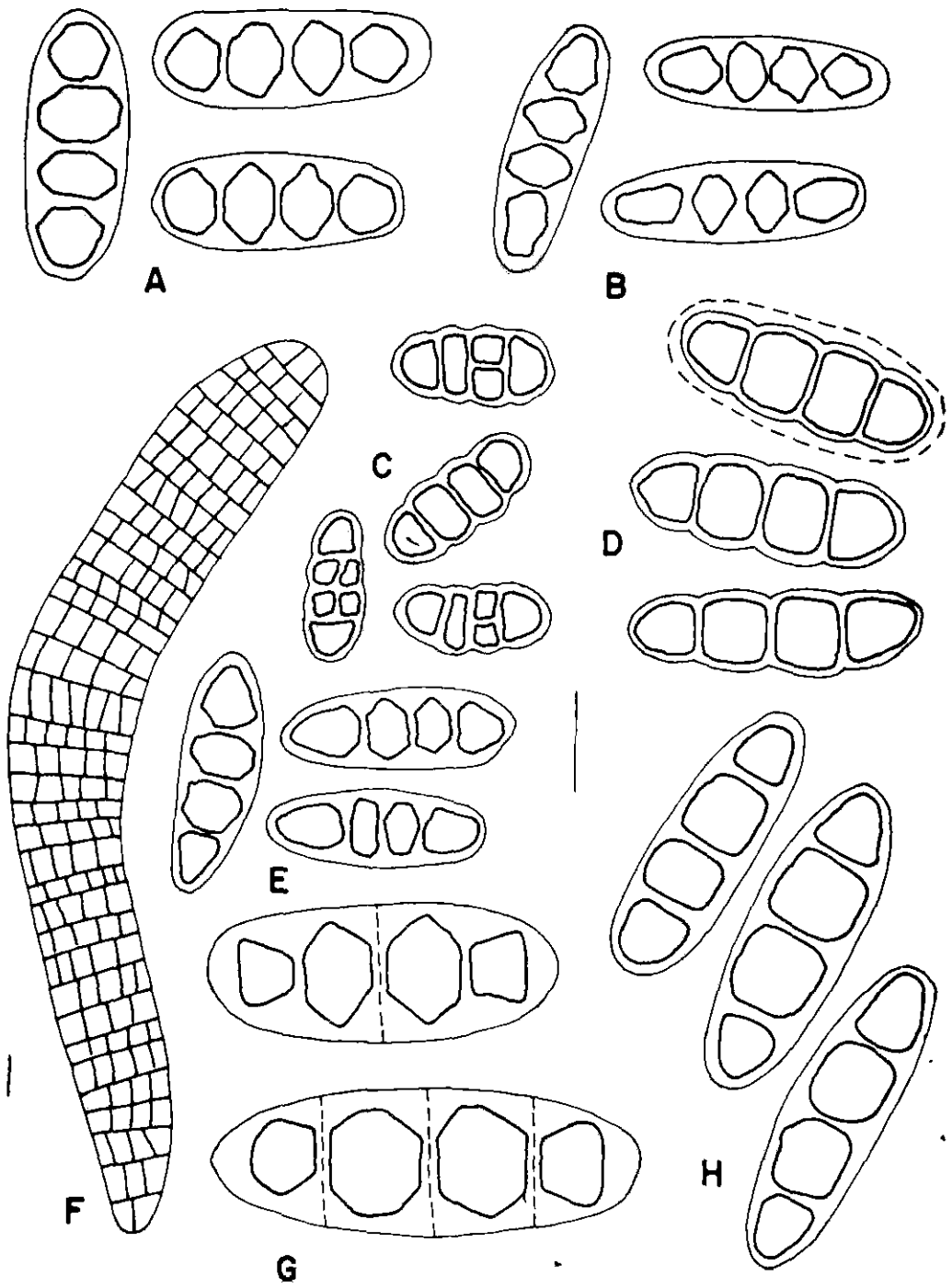


Fig. 2. Spores (all drawn from type collections). Bar = 10  $\mu$ m. A. *Astrothelium interjectum*; B. *Astrothelium pseudocypbellatum*; C. *Exiliseptum ocellatum*; D. *Lauerera aurata*; E. *Polymeridium biloculare*; F. *Trypethelium neogalbineum*; G. *Trypethelium buckii*; H. *Trypethelium violascens*.

6(7): 196. 1915. Holotype: Guadeloupe, Safraga, on *Inga laurina*, Duss 1415 (TUR-Vainio 30778).

This is a member of the *T. annulare* group distinguished by the spore size and rugose-bullate thallus. See the discussion of *T. buckii*.

Distribution. Lesser Antilles, Trinidad, Tobago and French Guiana.

Specimen examined. AMAZONAS: Barra (Manaus), Spruce 257 (BM).

*Trypethelium violascens* R. C. Harris sp. nov.

*Trypethelium* parietibus ascomatum crystallis aurantiacis KOH+ purpureis et sporis 4-locularibus parietibus et septis tenuibus, 28-33 x 8-10  $\mu$ m, IKI violascentibus.

Holotype: Brazil, Amazonas, along Igarapé Caititu off Rio Uatumã at Antônio Filinto. 01°45'S, 59°40'W, Buck 2937 (INPA). Isotypes in NY and to be distributed.

Thallus greenish tan, shiny, smooth or irregularly roughened, corticate with a white medulla filled with colorless crystals; UV-. Ascomata scattered, solitary or a few closely aggregated with carbonized walls fused but ostioles separate, immersed. Hymenium not interspersed. Spores 8/ascus, biseriate, 4-celled, fusiform, 28-33 x 8-10  $\mu$ m, IKI+ violet; spore walls and septa only slightly thickened. (Fig. 11).

The relatively thin walled IKI+ spores ally *T. violascens* with the Cuban *T. infuscatulum* Müll. Arg. which differs in having extensive black chain-like and interconnected pseudostromata lacking any reaction with KOH. The lack of spore wall thickening seems to represent a sporadic occurrence of a character found in the genera *Exiliseptum*, *Pleurotrema* and *Polymeridium* which I consider derived from *Trypethelium* by reduction.

Additional specimen examined. RORAIMA: Acampamento do 6º BEC-Jundiã on Manaus-Caracará Rd. ca. 328 km from intersection of Manaus-Itacoatiara Rd, Buck [Dumont BR 347] (INPA, NY).

## RESUMO

A posição das Trypetheliaceae é discutida e redefinida apresentando nove gêneros, a saber: *Astrothelium*, *Campylothelium*, *Cryptothelium*, *Exiliseptum* gen. nov., *Laurera*, *Pleurotrema*, *Polymeridium*, *Pseudopyrenula* e *Trypethelium*. Destes gêneros, alguns são claramente artificiais, mas sendo conservado até um estudo mais minucioso. Dos nove gêneros, seis são relatados para Amazônia brasileira: *Astrothelium* (13 spp.), *Cryptothelium* (2 spp.), *Exiliseptum* (1 sp.), *Laurera* (4 spp.), *Polymeridium* (4 spp.), e *Trypethelium* (11 spp.). Foram descritas 10 espécies novas: *Astrothelium gigasporum*, *A. interjectum*, *A. pseudocypbellatum*, *Cryptothelium amazonum*, *C. rhodotitthon*, *Laurera aurata*, *Polymeridium biloculares*, *Trypethelium buckii*, *T. neogalbineum* and *T. violascens*. Ainda foram propostas dez combinações novas, a saber: *Exiliseptum ocellatum* (Müll. Arg.) R.C. Harris, *Laurera subdisjunta* (Müll. Arg.) R.C. Harris, *Pleurotrema*



*acrophæna* (Müll. Arg.) R.C. Harris, *Polymeridium albidum* (Müll. Arg.) R.C. Harris, *P. catapastum* (Nyl.) R.C. Harris, *P. pleiomeroides* (Müll. Arg.) R.C. Harris, *Trypethelium floridanum* (Zahlbr. ex Choisy) R.C. Harris, *T. nitidiusculum* (Nyl.) R.C. Harris, *T. thelotremoides* (Nyl.) R.C. Harris e *T. tuberculosum* (Vainio) R.C. Harris. São apresentadas sinônimas completas para a família, os gêneros e as espécies aqui estudadas, e a chave de identificação.

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